

Response to Comments Document

Abrams Creek and Lower Opequon Creek TMDL for Benthic Impairment

On July 23, 2003, comments were received from Wayne Webb on the Abrams Creek and Lower Opequon Creek TMDL for Benthic Impairment. This document lists the comments received and provides a response for each, including modifications made to the TMDL model in response to the comments.

Comment 1

The proposed sediment TMDL for Abrams Creek and Lower Opequon creek should not be adopted. The reasons are many but the main reason is that any additional money or effort that is expended to meet the proposed sediment TMDL may be wasted and the benthic community not materially improved. There is no direct evidence that the cause of the “problem” is the current reported (calculated) maximum daily sediment load (138,531.9 Mg/year). The proposed TMDL (Table 1.8) 139,370.0 Mg/year is not substantially lower than the current load. That’s right the proposed TMDL is higher than the existing load for the watershed. So how is it going to help? If the benthic communities were harmed by the current loads how will a higher load help? Establishing a TMDL that is not substantially lower than the current load may have no effect and even one that is substantially lower may not result in improvement to the benthic communities.

Response

Mr. Webb is correct that in the previous draft of the TMDL report, the existing sediment load in the Lower Opequon was slightly lower than the existing sediment load in the reference stream. As a result of changes to other model parameters recommended by Mr. Webb (see response to Comments #8 and #15), the modeled sediment loads in both streams were significantly altered. The revised sediment loads resulting from this change were 57,648 t/yr in the Lower Opequon and 53,761 t/yr in the reference watershed. This now equates to a 6.7% higher sediment load in the Lower Opequon than in the reference watershed. DEQ believes that these modeling results more accurately represent the existing conditions and are consistent with the moderate to slight benthic impairment observed in the Lower Opequon. Once margins of safety and future growth expansions are considered, the TMDL will require a sediment reduction equivalent to 35.1% of the existing load (Table 1.8 in the Draft TMDL Report). DEQ believes that if these reductions are achieved, the benthic community will improve and meet State general standard for aquatic life use.

Comment 2

The report appears to have serious technical problems. There are several unrealistic results from the modeling of the basins. Not the least of which is that the average sediment concentration (528 milligrams per liter) required to produce the reported annual load for Abrams creek is at least one order of magnitude higher than is reasonable and 2 orders of magnitude greater than most the reported tss analyses for the Creeks. There are also some other puzzling, seemingly illogical, things presented in the report that appear to be built into the model.

Response

The actual mean annual in-stream sediment concentration for Abrams Creek as simulated by the revised model is 401 mg/L. This is indeed higher than the observed concentrations shown in Figure 4.1, but this figure represents only monthly grab samples, which do not routinely capture storm event flows. The model, however, simulates all storm loadings during the modeled time period. During major runoff events, sediment concentrations in runoff often increase by 2 to 4 orders of magnitude and mean concentrations on the range of 400 mg/L are therefore to be expected. In addition, because of the channel erosion in Abrams Creek, a significant portion of the sediment load would be coarse sediment particles that move as bedload (particles that roll or bounce along the streambed). The grab samples collected from Abrams Creek capture the suspended load in the water column, but miss the bedload component. The simulated sediment loads consider both suspended load and bedload and would thus be expected to be much higher than the observed TSS sediment data. The revised report was modified to better describe the connection between TSS measurements and sediment loads.

Comment 3

Arguing that establishing a sediment TMDL can't hurt is wrong. Tax money and other resources that would be required to meet the TMDL, based on no sediment data, could be better spent determining why there is a "problem" and then doing something about the "problem" if there is truly a problem.

Response

In order to identify the cause of the benthic impairments in Abrams and Opequon Creeks, DEQ conducted a stressor identification analysis in accordance with EPA's Stressor Identification Guidance Document (USEPA, 2000). Based on ambient water quality monitoring, benthic and habitat assessment, modeling of sediment loads, in-stream observations, and best professional judgement, this analysis determined that the most probable stressors included excessive sedimentation and habitat alteration. Because all lines of currently available evidence point towards these two causes, DEQ believes that additional time and money expended to further verify cause and effect relationships would be unnecessary and better spent on correcting problems that are already identified.

To address the most probable stressors identified in these streams, a TMDL for sediment was developed. Because habitat alteration is not a pollutant for which a load can be quantified, a TMDL could not be specifically developed to address the problem of habitat alteration. The interrelation between habitat alteration and sedimentation, however, allows many of the habitat alteration concerns to be concurrently addressed by the sediment TMDL. Best management practices that are expected to be used in reducing sediment loads will also benefit habitat conditions. The draft TMDL was revised to more explicitly describe the two most probable stressors and the relationship between them.

Comment 4

There are many sediment controlling practices (bmp's) already in place that were apparently ignored in this report. These practices will go a long way in holding the line on sediment yields from new developments. The Virginia State erosion and sediment control laws are enforced for all new developments of more than 10,000 square feet. Among other things these laws prohibit the post development peak flows for the 2-year storm from exceeding the 2-year predevelopment peak for discharges to natural channels. The 10-year post peak must be the same as before for man made channels. These peak flow laws result in storm water detention ponds being created by

land developers through out the Counties and City. The storm water detention ponds are often used as sediment basins during construction and they act to control sediment after construction is finished. All new developments must design all ditches and other storm water pathways to prevent erosion. The City sweeps its streets. On site sediment and erosion controls are required for all construction sites of more than 10,000 square feet. The communities are all ready spending a lot of private and public money to control sediment.

Response

Although unintentionally omitted from the original draft report, existing BMPs were considered within the model results. Post-processing of the model results accounts for sediment reductions due to all BMPs reported to the Department of Conservation and Recreation under its agricultural cost-share and E&S programs and by the Department of Forestry, and calculated by the Chesapeake Bay Program for incorporation into the Watershed Model. A description of these procedures has been added as Section 6.4.4 in the revised TMDL report.

Comment 5

The benthic communities could be responding to contamination in the stream bed sediments. To rule out the possibility that the stream sediments are contaminated, there needs to be a well planned study of the metal and organic content of the stream sediments before establishing a sediment TMDL. Winchester is a relatively old town and there is a very good likelihood that the bed material (fine grained sediments) of Abrams Creek is contaminated. There could be metals from old tanneries, lead from orchard pesticides used in the past, or arsenic from metal plating industries or organics such as pcbs from old transformers or solvents from machine and metal working shops that may have contaminated the sediments of Abrams Creek and the portion of Opequon Creek down stream of the confluence.

Response

In the revised TMDL report, an analysis of available sediment data from Abrams and Opequon Creeks was added. Sediment was collected from Abrams and Opequon Creeks in 1996, 1999, and 2001 and analyzed for toxic metals and toxic organics. Based on an evaluation of the available data, sediment toxicity was determined to be a non-stressor. Only one parameter in each stream segment, chlordane in Abrams Creek and mercury in the Lower Opequon, exceeded probable effect levels, and these exceedances were in 2001 after the benthic impairments were observed.

Comment 6

If the sediments in the Creeks are not contaminated, at least three years of actual sediment load measurements of the Creeks should be obtained to establish a basis for a sediment TMDL and standard with which to measure any future change in sediment load. If the loads provided in the TMDL report are an order of magnitude to high the TMDL is also an order of magnitude to high. There is no bench mark to demonstrate that a proposed sediment TMDL is being met or exceeded. There are no current or long term suspended sediment or bed load records for Abrams Creek or Opequon Creek.

Response

While management practices during implementation will be targeted at controlling sediment, the requirements of the TMDL will be met when the benthic community is measured as having recovered to a healthy or non-impaired state. Therefore, measurement of the benthic community will continue and will be the measure of success during TMDL implementation. This is appropriate because the listing of an impairment was initially based on benthic assessments. This approach is also appropriate because best management practices will not merely result in the reduction of sediment but will also benefit the benthic community by improving other aspects of habitat condition. During implementation plan development, additional monitoring programs specifically focused on measuring sediment loads could be implemented if such programs were deemed to be beneficial and cost effective.

Comment 7

Total suspended solids and turbidity concentration analyses are only an approximation of the fine grained low density suspended sediment concentration. The TMDL document states that for Abrams Creek: “4.2.1. Non-Stressors Total suspended solids (TSS) data (Figure 4.1) indicate predominantly low levels within normal ranges, with one very large spike in 1998). Turbidity data (not shown) parallels TSS data. The 1998 spike was not considered sufficient to cause the impairment, so TSS does not appear to be a stressor.”

Thus even the data that is available indicates no problem yet the development of the TMDL proceeded. The sediment concentration required to produce the reported average annual load for Abrams Creek is at least one order of magnitude to high for sediment concentrations in this environment. The current sediment load for Abrams Creek is reported to be 12583 Mg/year. The average stream flow was 26.6 cfs during 1983 to 1990 (The time period used to compute loads). This results in an average sediment concentration of 528 milligrams per liter. Concentrations of this magnitude are only observed during major flood events in this area. Of the approximately 300 tss samples collected from Abrams and Lower Opequon Creek from 1996 to 2002 only 11 contained more than 30 mg/L tss. Ten samples contained 30 to 150 mg/L and one on Abrams Creek contained 1140 mg/L tss.

Response

See response to Comment # 2. In addition, the TMDL report was revised to better explain the relationship between TSS measurements and sediment loads. Ambient monitoring data, which is not designed to focus on storm events, typically shows low levels of total suspended solids. During storm events, however, TSS concentrations are orders of magnitude higher, as indicated by the few large peaks in TSS during ambient monitoring. During these events, sediment from channel erosion, erosion from adjacent land surfaces, and transport of the sediment bedload may produce excess sedimentation despite low TSS values during non-event sampling.

Comment 8

The channel erosion component is listed as the largest existing sediment source and the one with the greatest increase in all areas. The rates given in this report seem unreasonably high. The total existing channel erosion shown in table 7.10 is 118,744.5 Mg/year and the total stream length was listed as 257,667 meters in table 6.10. Thus each meter of stream must provide 0.46 Mg/year of sediment. If the in place density of soil is 1.8, each meter of stream losses 0.25 cubic meters of earth a year. Projecting back only 50 years, every meter of stream should have provided 12.5 cubic meters of soil.

Response

Based on this and other comments by Mr. Webb, the channel erosion component of the model was re-evaluated. This evaluation determined that increased channel erosion in the model was in part due to elevated curve numbers that resulted from the hydrologic calibration. Based on other comments by Mr. Webb, the curve numbers were modified by directly selecting curve numbers from TR-55 guidance rather than using curve numbers as a calibrated parameter (see response to Comment #15). In addition, the default streambank height used in the channel erosion calculation was changed from 1.5 meters to 1.0 meters to better represent the mean channel cross-sections in the reference and TMDL watersheds. The last change made in the modeling process involved decreasing the amount of urban area in the watershed by reclassifying areas of “urban grass” and pervious areas of “low density residential” into the “%undeveloped area”. This reduced channel sediment loads because “%developed area” is a sensitive parameter in the channel erosion submodel. As a result of these modifications to the channel erosion component, modeled channel erosion was significantly reduced. The channel erosion component was reduced from 118,745 t/yr in the draft TMDL to 40,029 t/yr in the revised TMDL report.

Comment 9

The life forms in streams are greatly influenced by the land use in upstream tributary areas. To expect the life forms in a stream whose tributary area is an agricultural and urban/industrial area to be the same after development as they were before development is the same as expecting to see the same life forms in an urban parking lot as one would see in that area before it was developed. No reasonable person would expect anything like that so why do we expect it of streams?

Response

All state waters are designated for uses that include the propagation and growth of a balanced, indigenous population of aquatic life (9 VAC 25-260-10). The state’s general narrative standard protects this designated use (9 VAC 25-260-20). Section 303(d) of the Clean Water Act and Section 62.1-44.19:7.C of the Code of Virginia requires DEQ to develop TMDLs for waters that do not meet these applicable state water quality standards. While it may be more difficult to restore aquatic communities in urban streams, it is not impossible and the law requires it.

Comment 10

The bulk (14) of the meager number of (17 samples total*) biologic sample data on which the Creeks have been classified as impaired was collected during a drought condition when the sediment loads would be small. All the samples were collected in months when the monthly average stream flow of the S F SHENANDOAH RIVER AT FRONT ROYAL was less than the monthly average for the about 70 years of record. Thus, one would expect the benthic community to respond favorably to the low loads they experienced during the drought. The fact that they did not respond by becoming more diverse and more like the high mountain stream reference site indicates it is not the magnitude of the maximum daily sediment load that is impacting the communities.

Response

While total annual loads of sediment are likely lower during drought years than higher flow years, the impact of sediment on the benthic community is not necessarily reduced in drought years. A single storm event or ongoing channel erosion in the absence of rain events can deposit

sediment that may blanket or impact the benthic community. Drought conditions also do not provide the very high flow events that flush deposited sediment from the system, therefore sediment may accumulate in the substrate over longer time periods.

Comment 11

*Biological monitoring has been performed by VADEQ in the Abrams Creek watershed from October 1994 to October 2001 at the ABR000.78 benthic monitoring site. During this period, all 7 benthic samples were rated as “moderately” impaired. This Biological monitoring has been performed by VADEQ in the Lower Opequon Creek watershed from October 1994 to May 2002 at the OPE029.61 benthic monitoring site. During this period, 5 of the 9 benthic samples were rated as “moderately” impaired, with the remainder receiving a rating of “slightly” impaired.

Comparing Abrams Creek to Straight Creek is not a reasonable comparison. It appears Straight Creek biologic sample results were used to define Abrams Creek samples as “moderately impaired”. Straight Creek is a mountain stream elevation 3242 feet, about 1 tenth the area of Abrams Creek with 57 people, 2400 feet (988.3 versus 235.9 meters Table 5.1) higher in elevation, no sewage, no urban area and 78% forest. A much more reasonable comparison would be upper Opequon Creek, the one used to develop the sediment loads.

Response

Straight Creek represents the best available reference site for use in evaluating the health of the benthic community in Abrams Creek. The goal in selecting a reference site for a benthic assessment is to find a similar stream within the ecoregion that does not have anthropogenic impacts. The assessment is designed to compare the benthic community to a pristine condition, thus separating out the effect of human activities in the watershed. Because the Upper Opequon Creek watershed contains moderate levels of human activity, this stream was not appropriate as a reference for the benthic assessment. Upper Opequon Creek, however, was appropriate for use in determining a reference sediment load, because the objective of the TMDL is not to compare with pristine conditions but to compare with a similar but unimpaired watershed.

In addition to comparison to a reference site, the benthic community was compared to an objective standard. Virginia DEQ is in the process of converting to the use of a stream condition index (SCI) for measuring the quality of benthic communities. Using this index, streams with an SCI score below 56.3 are considered impaired. Average SCI scores for Abrams Creek were 45.4, and average SCI scores for Opequon Creek were 49.0, indicating impaired benthic communities for both streams.

Comment 12

Further it seems unreasonable to define the entire main stem of Abrams Creek as moderately impaired based on one sampling site at the mouth of the stream.

Response

Due to limited resources, DEQ is unable to locate multiple sampling stations on every stream. Because the downstream station was determined to be impaired, a TMDL would be developed for the entire watershed regardless of the results of upstream stations. In addition, the landuse along Abrams Creek is relatively consistent and there are no major tributaries. For these reasons, a 10-mile segment length is reasonable.

Comment 13

Why use the Upper Opequon as the reference stream? It has some similar land use parameters. But is there data to support it is more fishable or swim able? Does the Upper Opequon have concurrent biologic data that indicates it is not impaired? If the data exists why was Abrams Creek and Lower Opequon not compared to that data?

Response

See response to Comment #11. A benthic assessment was performed on Upper Opequon Creek, and this assessment showed that the stream was not impaired. The results of this assessment were included as Section 5.2.3 in the revised TMDL report. Upper Opequon Creek was used to obtain a reference sediment load because the watershed is similar to Abrams Creek but is unimpaired. Upper Opequon Creek was not used as a reference for the benthic assessment, because it did not meet the criteria for a benthic reference site (see response to Comment #11) and it was not monitored for the same period as either Abrams Creek or the Lower Opequon Creek.

Comment 14

A TMDL for sediment is a very difficult concept. The occurrence of interval of the TMDL has not been defined. The report states : “The average annual sediment load in metric tons per year (Mg/yr) from the area-adjusted Upper Opequon Creek defined the TMDL sediment load for Abrams” Creek in Table 1.1”.

Does that mean that the maximum daily load can be as much as the average annual load? Or must the average annual load be divided by 365 to obtain the “total maximum daily load”? What is the time period? Are we talking about the daily maximum averaged over a year or a month or a week or forever? Sediment load is the product of stream flow times sediment concentration. The stream flows of unregulated streams covers at least 3 orders of magnitude. Sediment concentrations also usually cover 3 orders of magnitude. In streams like Abrams and Opequon as stream flow increases the sediment concentration also increases. Thus with high stream flow there are high sediment loads. A reasonable rule of thumb is that 90 percent of the annual sediment load of a stream occurs in less than 5 percent of the time. We can never control the sediment load of a catastrophic flood. There is not enough money or space in the Valley to control the sediment load of the maximum probable flood. Wet years with floods are going to have much higher maximum daily sediment loads than drought years. The stream flow and thus the maximum daily sediment load will be much lower in dry months than wet months. Thus if we persist in having a sediment TMDL it must be related to a storm of defined frequency for example; the 2 or the 10-year storm and time of year.

Response

The concept of a TMDL for sediment differs from that of a TMDL for a conventional pollutant. For most conventional pollutants there are state standards that describe the concentration at which aquatic life or human health may be affected. In contrast, there are no state numeric standards for sediment, and sediment impacts on aquatic life are primarily due to the accumulated load deposited rather than the concentration in the water column. Because it is the accumulated load of sediment deposited in a stream that primarily affects the benthic community, the TMDL was based on an accumulated (or annual) load rather than a daily load. This concept

has been adopted by EPA for several other sediment TMDLs that address benthic impairments, such as TMDLs in Blacks Run, Cooks Creek, and Linville Creek.

Comment 15

The area weighted runoff curve numbers seem wrong. The most urbanized area Abrams Creek has the lowest CN. It is difficult to understand why the seepage coefficient for Abrams Creek is 0 but 0.02x for both reaches of the Opequon Creek.

Response

Based on this and other comments by Mr. Webb, the model calibration approach used in the draft TMDL was re-evaluated. Improvements in the methodology were made, the model was recalibrated, new model runs were generated, and revised TMDL sediment loads were calculated. In the draft TMDL, the curve numbers were initially calibrated in order to match the simulated and observed surface runoff volumes, with surface runoff determined through a HYSEP baseflow separation analysis. This calibration technique led to unusually high curve numbers. In the revised model, curve numbers were not calibrated, but were selected according to TR-55 guidance. Surface runoff was adjusted through the choice of pervious/impervious divisions for different urban land uses, through the choice of surface conditions chosen to represent urban pervious areas, and through the evaluation of cover conditions related to various land uses. The limited options available for adjusting simulated surface runoff were not sufficient to match surface runoff volumes estimated through baseflow separation. Since the integrity of the curve number method was judged to be more important than the baseflow separation, the percent baseflow criteria was dropped. The new calibration criteria became matching total streamflow and the seasonal distribution of flows.

The seepage coefficients were calibrated parameters for both Abrams and Upper Opequon Creeks. The seepage coefficient for the Lower Opequon Remnant was calculated as an area-weighted average of the two upstream calibrated watersheds, as there was no flow data for calibration in the Lower Opequon Remnant. The seepage coefficient represents losses to deep storage, so you would expect this value to be “0” for the Abrams Creek watershed since it has a number of large, year-round active springs.

Comment 16

The curve numbers shown in Table 6C for LDR-pur, MDR-pur, and HDR-pur are the commonly accepted values for those land uses and include the impervious area in those land uses. Thus including an increased curve number e.g. 98 for the impervious parts of those areas double accounts for the impervious area in those land uses and results in an over estimate of runoff.

Response

The pervious urban land use curve numbers have been corrected to account for the area-weighted nature of urban land use curve numbers that were developed to include both pervious and impervious areas. These are included in Table C.6 in the revised report.

Comment 17

The curve numbers in Table 6.12. “GWLF Land use Parameters – Existing Conditions”(below) are unrealistically high. Which may mean some other parameter(s) were too low or the model is

lacking an important parameter if the CN values had to be set at the reported levels to make the flow model work..

Response

The curve numbers were modified in the revised TMDL report. See response to Comment #15.

Comment 18

Table c5 shows that except for 2 areas (OPEadj and UPPadj) there is no decrease in animal access to streams at 100 % build out yet there is a reduction in pasture of 4217 ha. It is also puzzling that none of the cattle in LOW have access to a stream and that the listed decrease in access is the same for all build out scenarios.

Response

The contractor conducted a windshield assessment at most road/stream intersections, and received confirmation from local NRCS staff, that wherever pasture land abutted streams in the Lower Remnant, fencing appeared to be in place preventing stream access for all dairy operations. A correction was made in the future scenarios to include proportionate reductions for the beef operations with stream access. These adjustments are shown in Table C.5 in the revised report.

Comment 19

The monthly base flows in table 6.7 seem unreasonable. There is a higher percentage of impervious area in Abrams creek than in the Upper Opequon. Yet the Upper Opequon is calibrated with lower base flows. Conventional wisdom is that with the same geology, as impervious area increases the base flow goes down and the surface runoff increases.

Response

Abrams Creek is spring fed, and as such has a larger percentage of its total flow originating as baseflow. This was also evident from sustained flows during the drought period of the past few years.

Comment 20

Why are the unit area loads different between watersheds? See table 7.1

Response

Different unit area loads are the result of differences in slope and soil erodibility variations that were evaluated by land use within each watershed.